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**Rosenzweig**

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(54) **ADJUSTING NETWORK OPERATIONS BASED ON USER FEEDBACK**

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(60) Provisional application No. 61/469,979, filed on Mar. 31, 2011.

(51) **Int. Cl.**
***H04L 29/06*** (2006.01)
***H04L 12/853*** (2013.01)

(52) **U.S. Cl.**
CPC ..... ***H04L 65/4092*** (2013.01); ***H04L 47/2416*** (2013.01); ***H04L 65/80*** (2013.01)

(58) **Field of Classification Search**
CPC ..... H04L 65/4092
See application file for complete search history.

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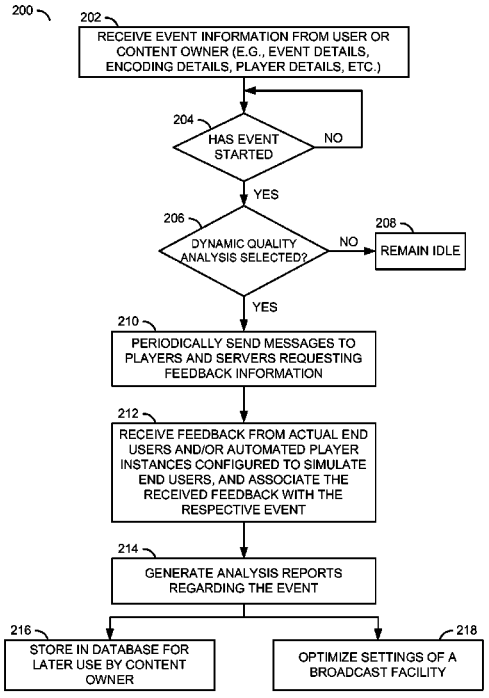
(57) **ABSTRACT**

A system comprising a broadcast facility, one or more players, and an analytic service center. The broadcast facility may be configured to provide a plurality of streams. The one or more players may be configured to receive at least one of the plurality of streams and provide feedback on a user experience. The analytic service center may be configured to receive the feedback from the one or more players.

**19 Claims, 6 Drawing Sheets**



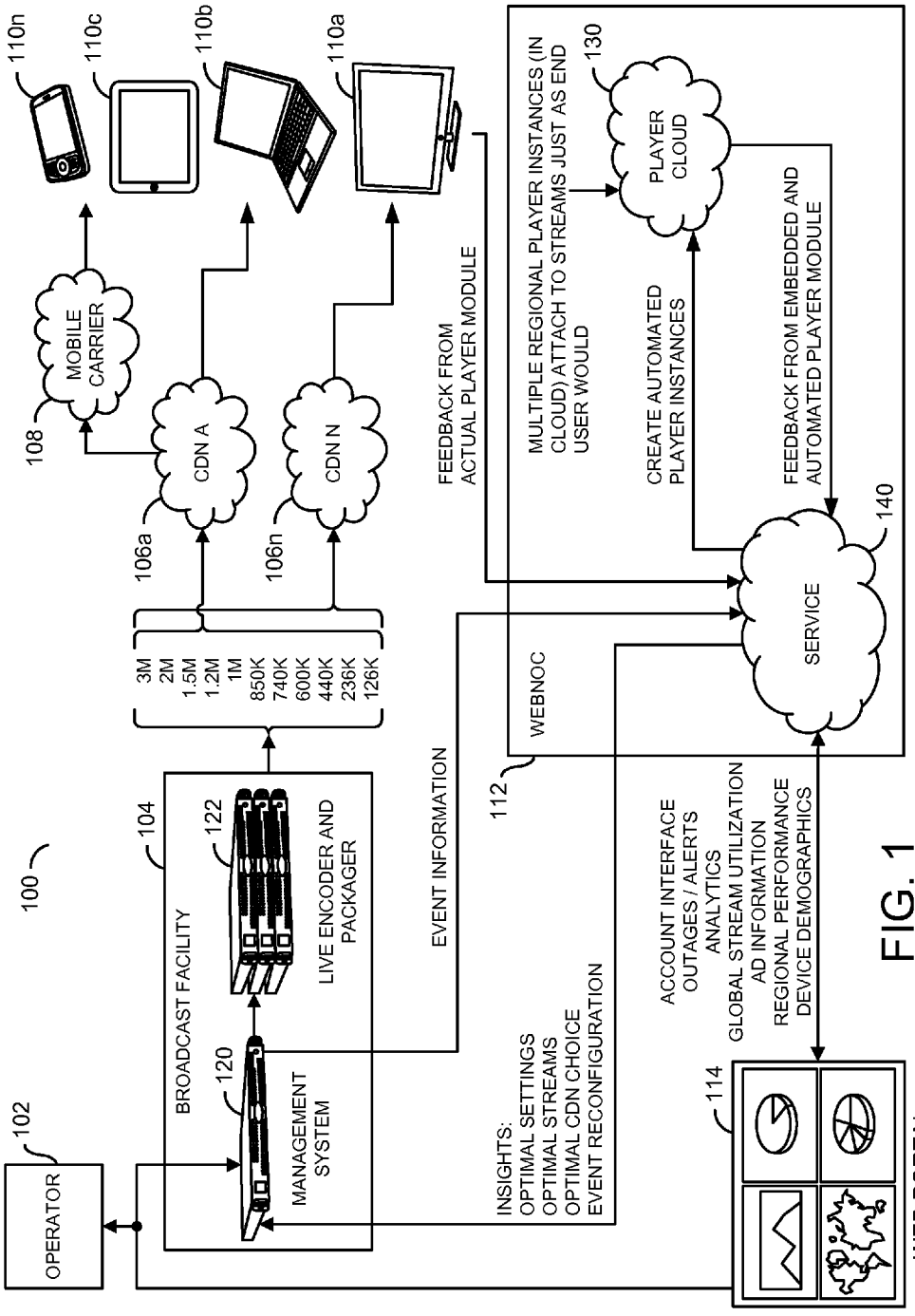

100
102
OPERATOR
104
BROADCAST FACILITY
120
MANAGEMENT SYSTEM
122
LIVE ENCODER AND PACKAGER
3M
2M
1.5M
1.2M
1M
850K
740K
600K
440K
236K
126K
106a
106n
CDN A
CDN N
108
MOBILE CARRIER
110n
110c
110b
110a
EVENT INFORMATION
INSIGHTS:
OPTIMAL SETTINGS
OPTIMAL STREAMS
OPTIMAL CDN CHOICE
EVENT RECONFIGURATION
112
WEBNOC
FEEDBACK FROM ACTUAL PLAYER MODULE
MULTIPLE REGIONAL PLAYER INSTANCES (IN CLOUD) ATTACH TO STREAMS JUST AS END USER WOULD
130
PLAYER CLOUD
CREATE AUTOMATED PLAYER INSTANCES
FEEDBACK FROM EMBEDDED AND AUTOMATED PLAYER MODULE
140
SERVICE
ACCOUNT INTERFACE
OUTAGES / ALERTS
ANALYTICS
GLOBAL STREAM UTILIZATION
AD INFORMATION
REGIONAL PERFORMANCE
DEVICE DEMOGRAPHICS
114
WEB PORTAL

FIG. 1

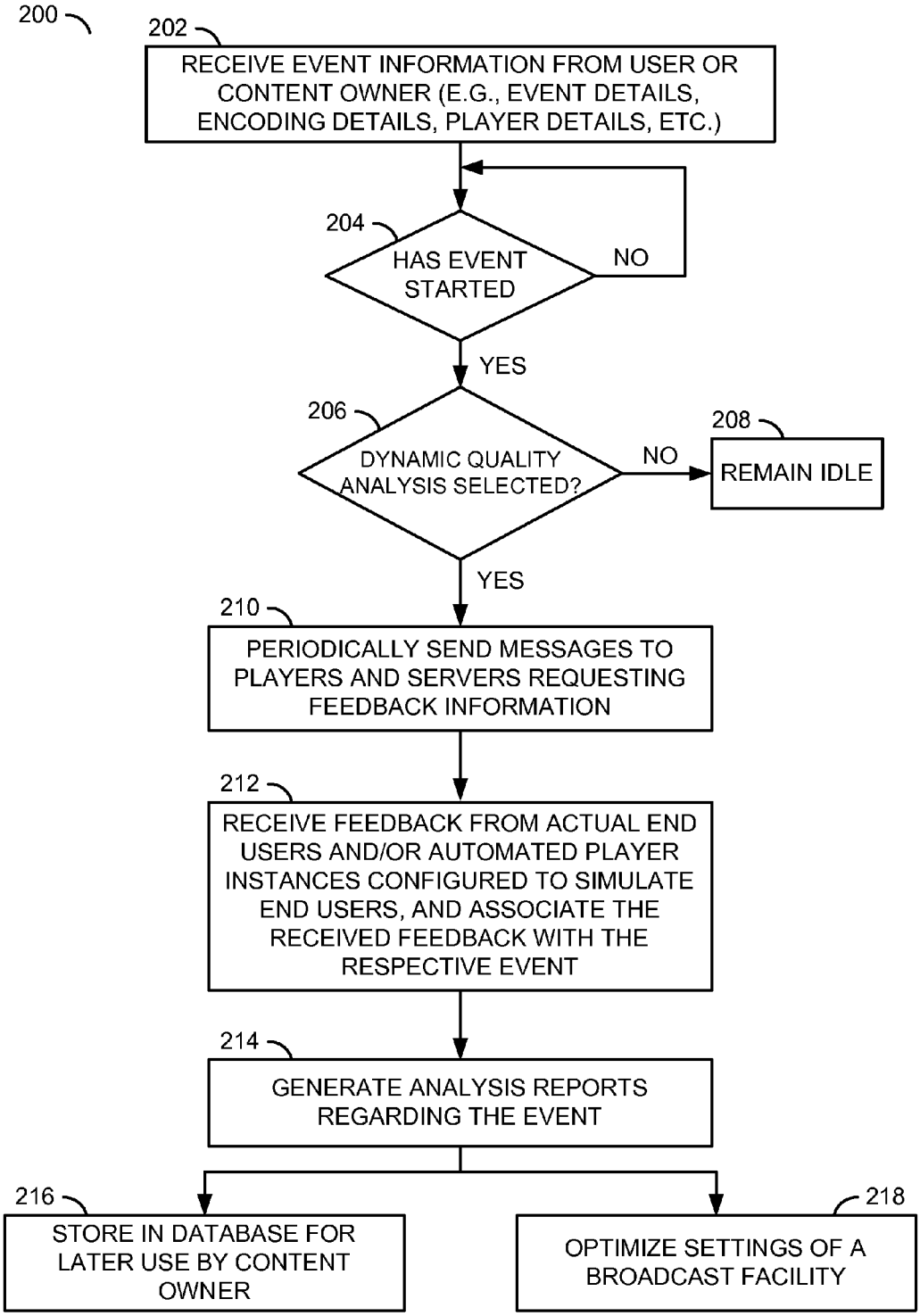

200
202
RECEIVE EVENT INFORMATION FROM USER OR CONTENT OWNER (E.G., EVENT DETAILS, ENCODING DETAILS, PLAYER DETAILS, ETC.)
204
HAS EVENT STARTED
NO
YES
206
DYNAMIC QUALITY ANALYSIS SELECTED?
NO
208
REMAIN IDLE
YES
210
PERIODICALLY SEND MESSAGES TO PLAYERS AND SERVERS REQUESTING FEEDBACK INFORMATION
212
RECEIVE FEEDBACK FROM ACTUAL END USERS AND/OR AUTOMATED PLAYER INSTANCES CONFIGURED TO SIMULATE END USERS, AND ASSOCIATE THE RECEIVED FEEDBACK WITH THE RESPECTIVE EVENT
214
GENERATE ANALYSIS REPORTS REGARDING THE EVENT
216
STORE IN DATABASE FOR LATER USE BY CONTENT OWNER
218
OPTIMIZE SETTINGS OF A BROADCAST FACILITY

FIG. 2

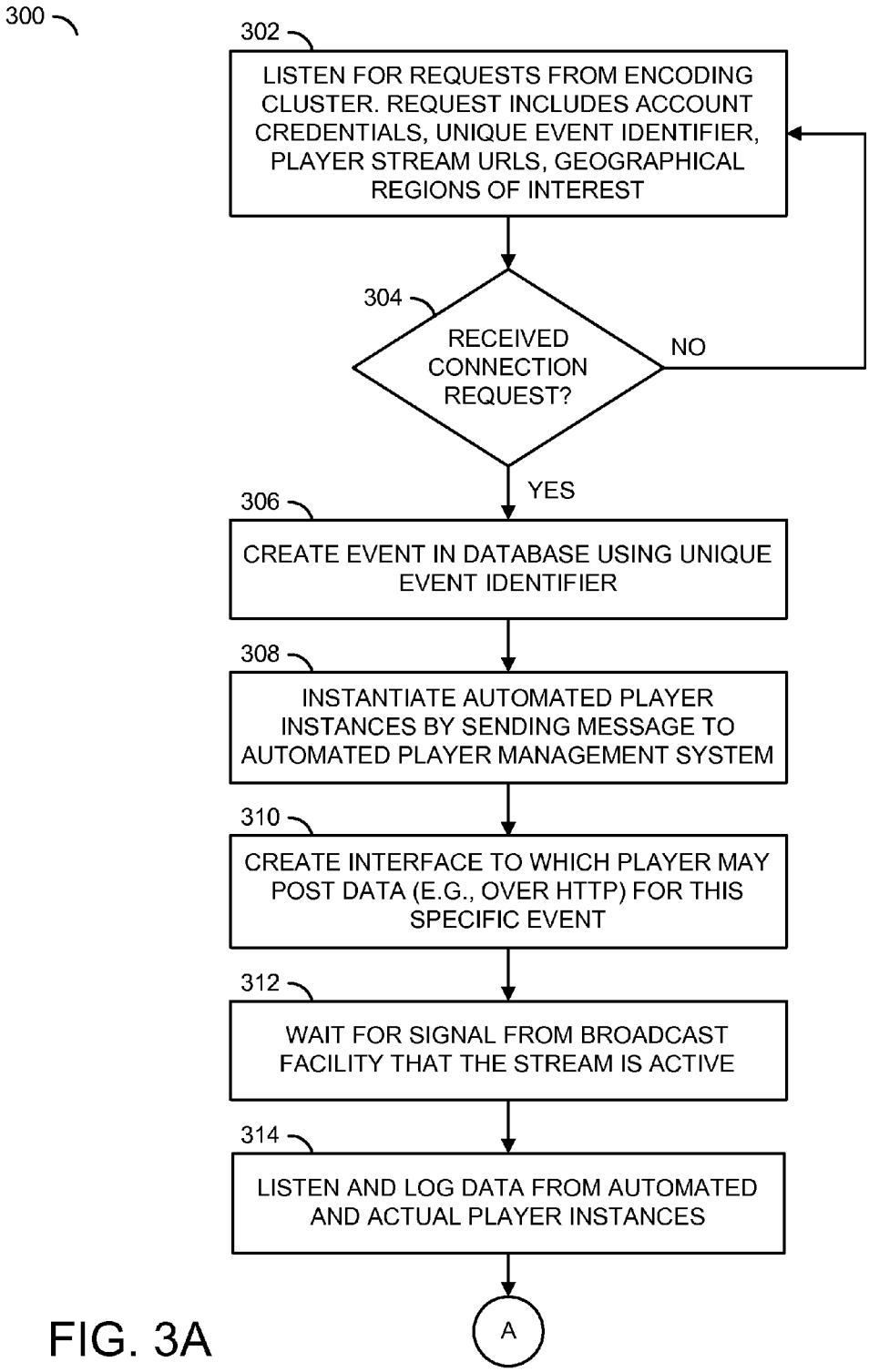

300
302
LISTEN FOR REQUESTS FROM ENCODING CLUSTER. REQUEST INCLUDES ACCOUNT CREDENTIALS, UNIQUE EVENT IDENTIFIER, PLAYER STREAM URLS, GEOGRAPHICAL REGIONS OF INTEREST
304
RECEIVED CONNECTION REQUEST?
NO
YES
306
CREATE EVENT IN DATABASE USING UNIQUE EVENT IDENTIFIER
308
INSTANTIATE AUTOMATED PLAYER INSTANCES BY SENDING MESSAGE TO AUTOMATED PLAYER MANAGEMENT SYSTEM
310
CREATE INTERFACE TO WHICH PLAYER MAY POST DATA (E.G., OVER HTTP) FOR THIS SPECIFIC EVENT
312
WAIT FOR SIGNAL FROM BROADCAST FACILITY THAT THE STREAM IS ACTIVE
314
LISTEN AND LOG DATA FROM AUTOMATED AND ACTUAL PLAYER INSTANCES
A

FIG. 3A

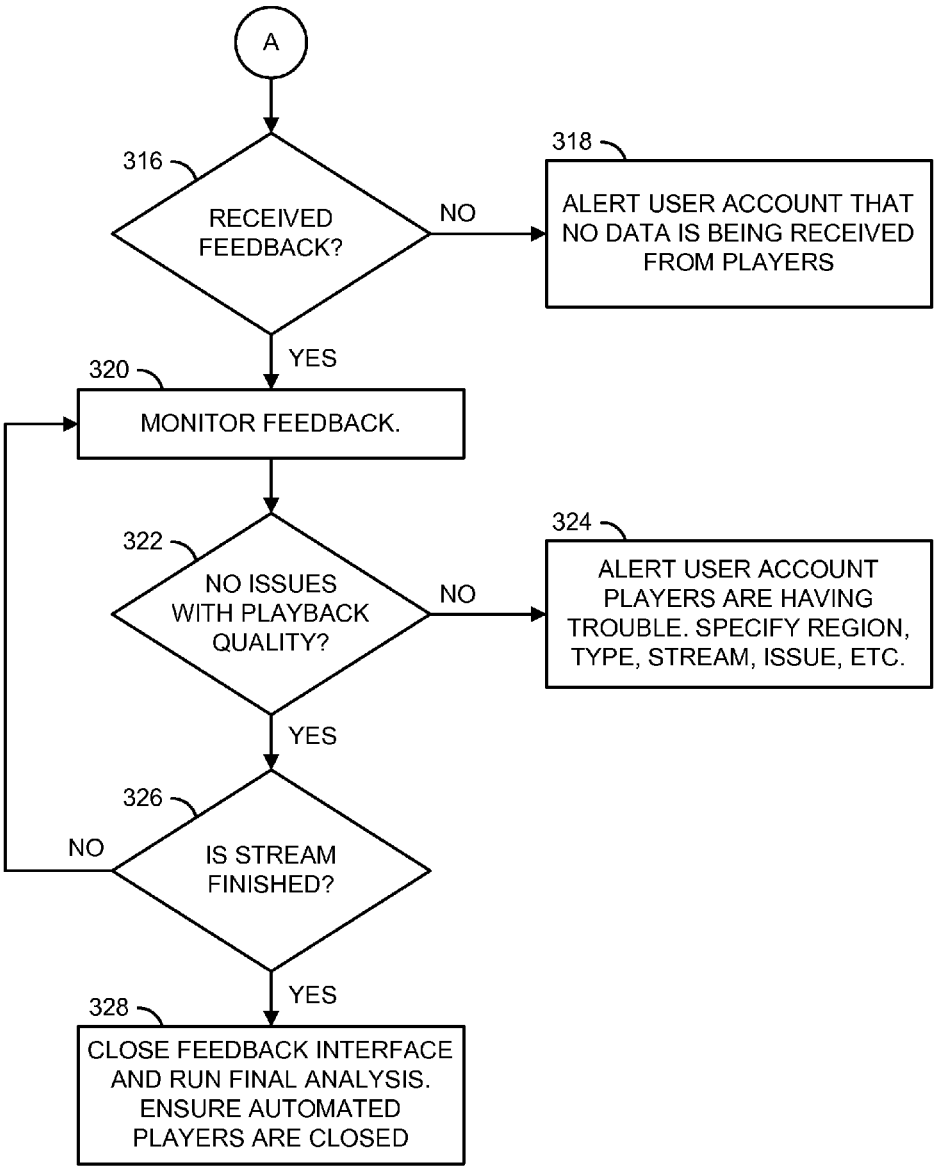

A
316
RECEIVED FEEDBACK?
NO
318
ALERT USER ACCOUNT THAT NO DATA IS BEING RECEIVED FROM PLAYERS
YES
320
MONITOR FEEDBACK.
322
NO ISSUES WITH PLAYBACK QUALITY?
NO
324
ALERT USER ACCOUNT PLAYERS ARE HAVING TROUBLE. SPECIFY REGION, TYPE, STREAM, ISSUE, ETC.
YES
326
NO
IS STREAM FINISHED?
YES
328
CLOSE FEEDBACK INTERFACE AND RUN FINAL ANALYSIS. ENSURE AUTOMATED PLAYERS ARE CLOSED

FIG. 3B

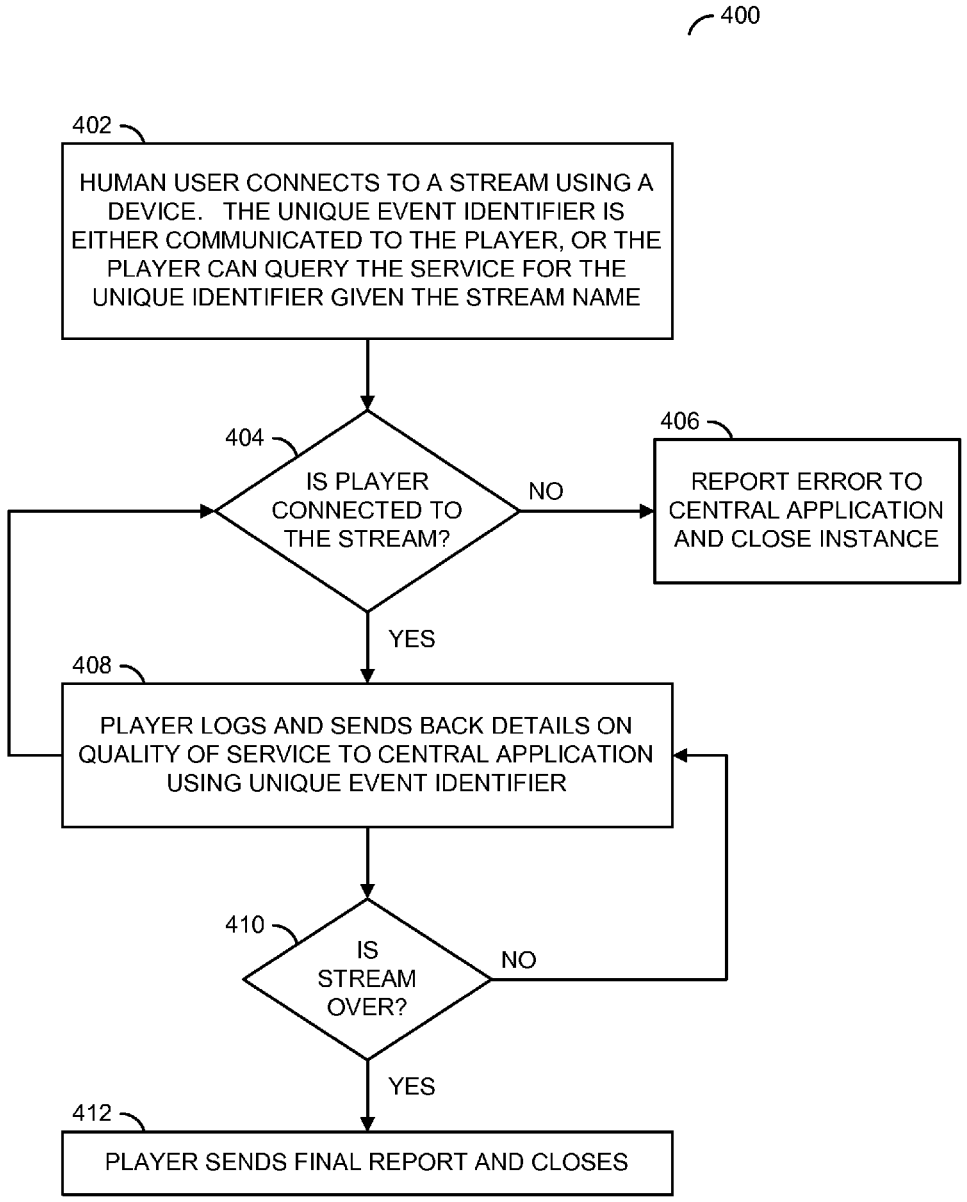

400
402
HUMAN USER CONNECTS TO A STREAM USING A DEVICE. THE UNIQUE EVENT IDENTIFIER IS EITHER COMMUNICATED TO THE PLAYER, OR THE PLAYER CAN QUERY THE SERVICE FOR THE UNIQUE IDENTIFIER GIVEN THE STREAM NAME
404
IS PLAYER CONNECTED TO THE STREAM?
NO
406
REPORT ERROR TO CENTRAL APPLICATION AND CLOSE INSTANCE
YES
408
PLAYER LOGS AND SENDS BACK DETAILS ON QUALITY OF SERVICE TO CENTRAL APPLICATION USING UNIQUE EVENT IDENTIFIER
410
IS STREAM OVER?
NO
YES
412
PLAYER SENDS FINAL REPORT AND CLOSES

FIG. 4

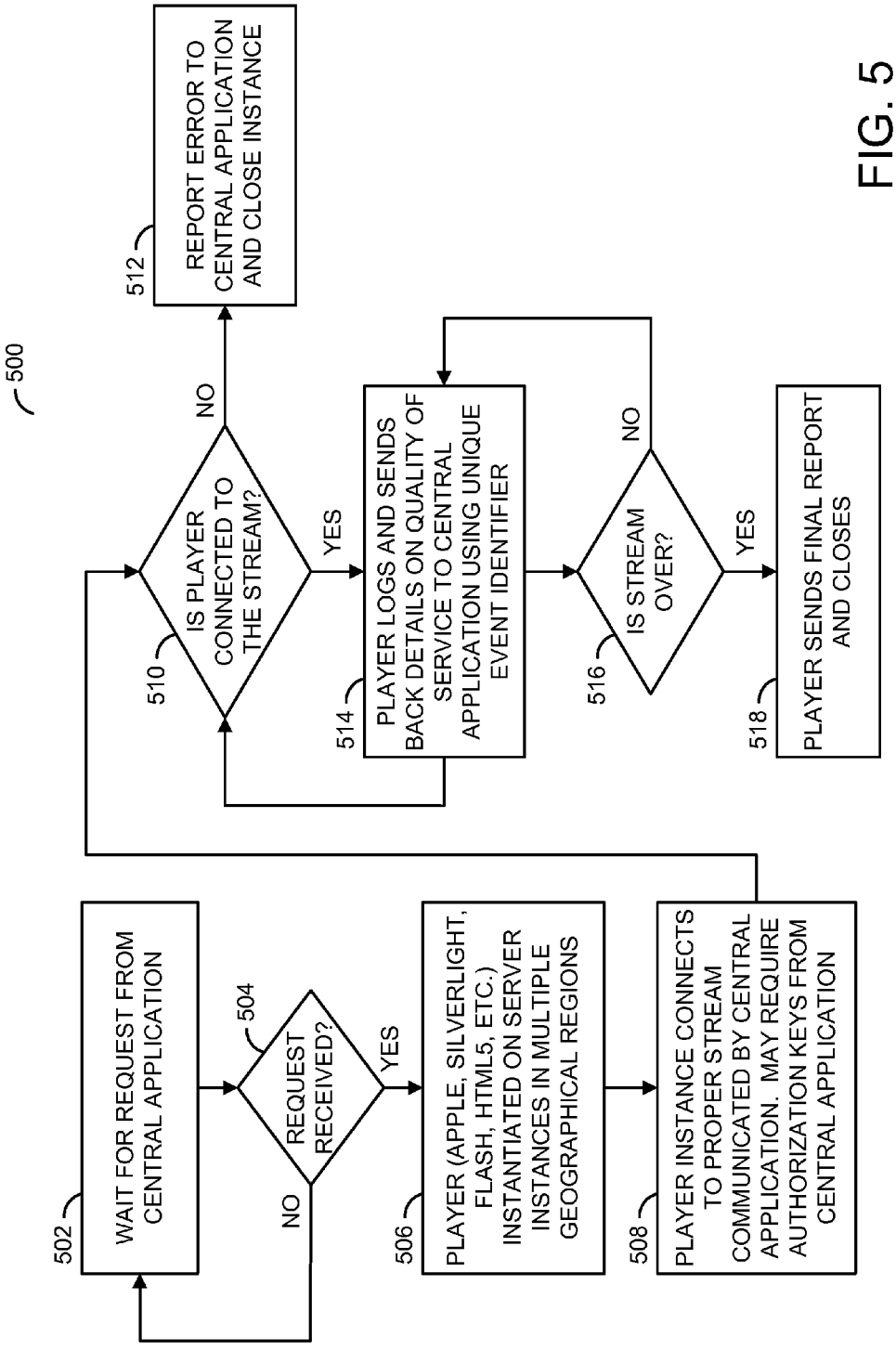

500
502
WAIT FOR REQUEST FROM CENTRAL APPLICATION
504
REQUEST RECEIVED?
NO
YES
506
PLAYER (APPLE, SILVERLIGHT, FLASH, HTML5, ETC.) INSTANTIATED ON SERVER INSTANCES IN MULTIPLE GEOGRAPHICAL REGIONS
508
PLAYER INSTANCE CONNECTS TO PROPER STREAM COMMUNICATED BY CENTRAL APPLICATION. MAY REQUIRE AUTHORIZATION KEYS FROM CENTRAL APPLICATION
510
IS PLAYER CONNECTED TO THE STREAM?
NO
YES
512
REPORT ERROR TO CENTRAL APPLICATION AND CLOSE INSTANCE
514
PLAYER LOGS AND SENDS BACK DETAILS ON QUALITY OF SERVICE TO CENTRAL APPLICATION USING UNIQUE EVENT IDENTIFIER
516
IS STREAM OVER?
NO
YES
518
PLAYER SENDS FINAL REPORT AND CLOSES

FIG. 5

# ADJUSTING NETWORK OPERATIONS BASED ON USER FEEDBACK

This application is a continuation-in-part of U.S. application Ser. No. 13/436,856, filed Mar. 31, 2012, which claims the benefit of U.S. Provisional Application No. 61/469,979, filed Mar. 31, 2011. All of the above-referenced applications are hereby incorporated by reference in their entirety.

This application is related to U.S. application Ser. No. 13/230,028, filed Sep. 12, 2011, U.S. application Ser. No. 13/323,007, filed Dec. 12, 2011, and U.S. application Ser. No. 13/412,954, filed Mar. 6, 2012. The above-referenced applications are hereby incorporated by reference in their entirety.

## FIELD OF THE INVENTION

The present invention relates to video distribution generally and, more particularly, to a method and/or architecture for a web based network operations center.

## BACKGROUND OF THE INVENTION

Content cached in a content delivery network or content distribution network (CDN) is generated by content producers. The content producers generate a fixed number of versions (or streams) of the content based on expected demand. Conventional content delivery solutions use an encoding device to produce several streams with a variety of predetermined encoding parameters simultaneously. The CDN delivers the content to an audience using the plurality of streams having the variety of encoding parameters. However, because the number of streams and variety of encoding parameters is fixed and the experience of consumers is not communicated to content producers, the conventional solutions can fail to provide the audience with an optimal experience.

Encoder settings are complicated. It can be difficult to know whether the encoding parameters are properly set, especially with adaptive bitrate streams across a variety of devices. An event creator may not have video expertise. The CDN may not be delivering good quality of service (QoS) to the end user. The conventional system does not have feedback on how many streams are enough. Thus, a conventional system can waste bandwidth across a network that could have been used to provide more bits for higher value content.

It would be desirable to implement a method and/or architecture for a web based network operations center.

## SUMMARY OF THE INVENTION

The present invention concerns a system comprising a broadcast facility, one or more players, and an analytic service center. The broadcast facility may be configured to provide a plurality of streams. The one or more players may be configured to receive at least one of the plurality of streams and provide feedback on a user experience. The analytic service center may be configured to receive the feedback from the one or more players.

The objects, features and advantages of the present invention include providing a method and/or architecture for a web based network operations center that may (i) provide media analytics for protocols including Pantos HTTP live streaming (HLS) from Apple, Inc., Smooth Streaming from Microsoft Corp., Adobe Zeri/Flash, etc., (ii) provide feedback optimization, (iii) provide media analytics on playback experience, (iv) provide media analytics on who is watching what, and/or (v) directly feed back insights to encoding device(s) for real-time optimization of content and distribution methods.



## BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of the present invention will be apparent from the following detailed description and the appended claims and drawings in which:

FIG. **1** is a diagram illustrating an example system in accordance with an embodiment of the present invention;

FIG. **2** is a flow diagram illustrating an example system level process using consumer feedback to adjust broadcast settings and inform content producers;

FIGS. **3**A-**3**B is a flow diagram illustrating an example central application process in accordance with an embodiment of the present invention;

FIG. **4** is a flow diagram illustrating an example player process in accordance with an embodiment of the present invention; and

FIG. **5** is a flow diagram illustrating an example automated player instance manager process in accordance with an embodiment of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the present invention may provide a system that brings the experience of the consumer of video content on any device to the producer of the content. The information provided by the consumer to the producer may provide the producer with insight into how to improve the experience of the consumer. The system may provide an automated quality control service to alert the producer of consumer problems as early as possible. The system may also help pinpoint where in a long chain of content processing any problems may be occurring. The system may also help the producer optimize the cost of delivery to the consumer by creating analytics on who is watching, in what regions, on what devices, using what content delivery mechanism (e.g., cable company, content delivery network (CDN) such as Akamai, mobile carrier (MC) such as Verizon, etc). A system in accordance with an embodiment of the present invention may put the end consumer in the loop with the initial content producer, especially with web based video formats (e.g., from Apple, Inc., Microsoft Corporation, Adobe, Google, etc.).

Referring to FIG. **1**, a diagram is shown illustrating a system **100** in accordance with an embodiment of the present invention. The system **100** generally provides a service to help content owners and distributers to improve the media experience. The system **100** may provide video analytics on quality of outgoing streams to all devices. Generation of the analytics may be integrated with encoding devices, allowing the encoding devices to be reconfigured on the fly. The system **100** may optimize settings for content, supply best settings for devices (e.g., through a setup wizard), and save CDN costs by measuring best QoS.

In one example, an operator **102** may create an event through a broadcast facility **104**. The broadcast facility **104** may generated a plurality of adaptive streams that may communicate event content via a number of content delivery networks (CDNs) **106***a*-**106***n* and/or mobile carriers (MCs) **108** to a number of end users. The end users may use a

number of actual player devices **110***a*-**110***n* to connect to the streams available from the CDNs **106***a*-**106***n* and MCs **108** and receive the event content. The actual player devices **110***a*-**110***n* may be configured to provide feedback to a web-based network operations center (WEBNOC) **112**.

The WEBNOC **112** may be configured to use the feedback from the player devices **110***a*-**110***n* to adjust operation of the broadcast facility **104** and inform the operator **102** about the end user experience with respect to the event. The WEBNOC **112** may be configured to (i) receive event information from the broadcast facility **104**, send insights (e.g. optimal settings, optimal streams, optimal CDN/MC choice, event reconfiguration, etc.) to the broadcast facility **104**, and (iii) make information (e.g., account interface details, outages, alerts, analytics, global stream utilization, ad information, regional performance information, device demographics, etc.) available to the operator **102** via, for example, a web portal **114**. The WEBNOC **112** may also be configured to facilitate concealment of errors in HTTP adaptive video sets using the techniques described in U.S. application Ser. No. 13/412,954, which is hereby incorporated by reference in its entirety.

In one example, the broadcast facility **104** may comprise a video encoding and packaging management system **120** and a live event encoder and packager **122**. The video encoding and packaging management system **120** may be implemented, in one example, using an Elemental Conductor system (available from Elemental Technologies, Portland, Oreg.). The live event encoder and packager **122** may be implemented using, for example, one or more Elemental Live units (also available from Elemental Technologies, Portland, Oreg.).

In one example, the WEBNOC **112** may comprise a player cloud **130** and a central application (or service) **140**. The live encoder and packager **122** generally communicates information with the service **140** including, but not limited to, settings, publishing points, digital rights management (DRM), player addresses, etc. When an event is started, the operator **102** may select whether or not to use dynamic quality analysis. When the event starts, a message is periodically sent to players as well as any server that is monitoring the streams. Feedback is sent back to the central service **140**. The central service **140** associates the feedback with the event (e.g., using a unique event identifier). The feedback may be accessed later through the video encoding and packaging management system **120** and the live event encoder and packager **122**. Analytics (e.g., media, etc.) for prior events and quality may also be viewed (e.g., through the video encoding and packaging management system **120**, the live event encoder and packager **122** or a standard web browser). The end user of a device or player (e.g., iOS, android, silverlight, flash, etc.) may also click a "feedback up or down" button and/or select from various instantaneous feedback (e.g., "blocky", "stuttering", "video stopped", "audio stopped", etc).

A database of settings versus content versus quality may be built. The database may be used later so that the operator **102** may have a one button "optimize" capability that would use a piece of content and have the server offer optimal settings. The system **100** may facilitate holding CDNs and Mobile Carriers more accountable based upon historical data. The operator **102** may use the database to analyze advertisement value and standardize on user experience metrics. Consumers may chose (or search) content based on a user experience metric. The database may also receive and store feedback generated by a system such as the one described in U.S. application Ser. No. 13/412,954, which is incorporated herein by reference.

In one example, the WEBNOC **112** may be implemented as a web service based application that receives event details from the producer and receives real-time feedback on performance (e.g., playback performance and quality) from the consumers. The feedback to the service comes directly from the devices consuming the content, such as tablets, phones, computers, set top boxes (STBs), etc. The feedback generation capability is generally built into the players and player devices. For example, the players and player devices may be configured to know how to report back to the central service **140**.

An automated player component may be implemented in the player cloud **130**. The automated player component generally allows the content producers to automatically test their content playback without the attachment of actual users. For example, automated player instances may be created, for example, in a cloud compute service such as Amazon Elastic Compute Cloud (Amazon EC2), Rackspace, or any of various private cloud infrastructures that are spread around the world. In one example, automated player instances may be created in different (e.g., geographically) regions. In another example, the automated player instances may be configured to support the decryption of digital rights management (DRM) information as a way of testing the proper operation of a DRM service. The decryption of digital rights management (DRM) information may also provide another test as to the quality of the streams and whether the streams are properly formatted.

In one example, instantiation of automated player instances in multiple regions may allow broadcasters to test whether geo-blocking algorithms are working correctly. In another example, content providers may test system load handling by starting a number of automated player instances. The automated player instances would allow content providers to monitor content delivery network performance and health over multiple regions. The automated player instances may also be configured to automatically adjust network performance to simulate mobile device bandwidth fluctuations.

In one example, the automated player instances may be generated via an automatic player management system. The automatic player management system may be configured to manage the starting and stopping of automated player instances, for example, in the computing resources cloud(s). The automatic player management system may be configured to start and stop player instances in multiple or targeted regions using combinations of technologies and player frameworks. The various player instances may include, but are not limited to, technologies based, for example, on Microsoft Silver Light players, Adobe Flash players, HTML5 players, iOS emulators, and Android emulators. The player frameworks may be based, for example, on OSMF (open source media framework), SMF, or any other player framework. Operating systems (OSs) may include, but are not limited to, OSs from Microsoft and Linux. The hardware generally comprises a range of hardware capabilities, including, but not limited to combinations of differing central processing unit (CPU) performance and graphics processing units (GPUs). Additionally, a custom analyzer system may be implemented that monitors stream quality independent from these other technologies. In one example, the players may be web based (e.g., running in a browser). In another example, the players may be independent of a browser. When feedback from actual users is also available, the feedback data may be of higher quality.

In conventional system content playback is tested by manually test the streams by the producers, which is very tedious and error prone. Other detail that may be provided by the encoding units **122** may include, but is not limited to, some unique event identifier (e.g., name, UUID, etc.). The unique event identifier would then be used later to match the feedback with the event and allow the content owners to determine how well the event worked. A system in accordance with an embodiment of the present invention may have features that may include:

Feedback Optimization;

New media analytics—Apple HLS, MS Smooth, Adobe Zeri/Flash playback experience and who is watching what; Insights fed back directly to encoding device(s) for real-time optimization of content and distribution methods.

As would be apparent to those skilled in the relevant art(s), the signals illustrated in FIG. **1** represent logical data flows. The logical data flows are generally representative of physical data transferred between the respective blocks by, for example, address, data, and control signals, wired and wireless channels, and/or busses. The various components of the system **100** may be implemented in hardware, software or a combination of hardware and software according to the teachings of the present disclosure, as would be apparent to those skilled in the relevant art(s).

Referring to FIG. **2**, a flow diagram is shown illustrating an example system level process **200** in accordance with an embodiment of the present invention. The process (or method) **200** generally uses consumer feedback to adjust (e.g., optimize) broadcast settings and inform content producers. In one example, the process **200** may comprise a step (or state) **202**, a step (or state) **204**, a step (or state) **206**, a step (or state) **208**, a step (or state) **210**, a step (or state) **212**, a step (or state) **214**, a step (or state) **216**, and a step (or state) **218**. In the step **202**, the process **200** may receive event information from a user or content owner (producer). The event information may include, but is not limited to event details, encoding details (e.g., video, audio, data), player details (e.g., edge addresses, digital rights management information, devices supported), etc. When the event information has been received, the process **200** may move to the step **204**.

In the step **204**, the process **200** may wait for the event to start. When the event has started, the process **200** may move to the step **206**. In the step **206**, the process **200** may check to determine whether a dynamic quality analysis has been selected by the user or content owner. When dynamic quality analysis has not been selected, the process **200** may remain idle. When dynamic quality analysis has been selected, the process **200** may move to the step **210**. In the step **210**, the process **200** may periodically send messages to players and servers requesting feedback information. When the request for feedback information has been sent, the process **200** may move to the step **212**. In the step **212**, the process **200** may receive feedback from actual end users and/or automated player instances created to simulate end users. The process **200** associates the feedback received with the respective event.

In one example, the feedback information (e.g., from embedded and automated player instances) may include, but is not limited to receiving bandwidth, CPU/dedicated decoding hardware utilization by decoder, frame decoding time/rate of video frames that are not displayed (e.g., dropped frames), native resolution of display device, whether player is in full screen mode or not, window size of player (e.g., when not in full screen mode), Profile/Level capability of decoder device, captioning, AV sync time stamps, whether an advertisement is being played, etc. When the requested feedback has been received, the process **200** moves to the step **214**. In the step **214**, the process **200** may generate one or more an analysis reports regarding the event. In one example, the analysis reports may include, but are not limited to outages, alerts, analytics, global stream utilization, advertisement information, regional performance information, device demographics information. When the analysis reports are generated, the process **200** may move to the step **216** and/or to the step **218**. In the step **216**, the process **200** may store the reports in a database for later use by the user or content owner. In the step **218**, the process **200** may adjust settings of a broadcast facility (e.g., to optimize performance of the system). The steps **210-218** may be repeated periodically until the event ends.

Referring to FIGS. **3A-3B**, a flow diagram is shown illustrating an example central application process **300** in accordance with an embodiment of the present invention. In one example, the process (or method) **300** may comprise a step (or state) **302**, a step (or state) **304**, a step (or state) **306**, a step (or state) **308**, a step (or state) **310**, a step (or state) **312**, a step (or state) **314**, a step (or state) **316**, a step (or state) **318**, a step (or state) **320**, a step (or state) **322**, a step (or state) **324**, a step (or state) **326**, and a step (or state) **328**. In the step **302**, the process **300** listens for requests from one or more encoding clusters. The requests may include, but are not limited to account credentials, unique event identifiers, uniform resource locators (URLs) for player streams, geographical regions of interest, etc. Periodically, the process **300** moves to the step **304** where the process **300** determines whether a connection request has been received. When no connection request has been received, the process **300** returns to the step **302** and continues listening. When a connection request is received, the process **300** moves to the step **306**.

In the step **306**, the process **300** creates an event entry in the database using the unique event identifier from the request. The process **300** then moves to the step **308**. In the step **308**, the process **300** instantiates an automated player instance in the player cloud (e.g., by sending a message to an automated player management system). When the automated player instance has been created, the process **300** moves to the step **310**. In the step **310**, the process **300** creates an interface for the automated player instance to post feedback data for the particular event (e.g., using hypertext transport protocol (HTTP)). When the interface has been created, the process **300** may move to the step **312**. In the step **312**, the process **300** waits for a signal from the broadcast facility indicating that the stream associated with the particular event is active. Upon receiving the signal from the broadcast facility, the process **300** moves to the step **314**.

In the step **314**, the process **300** listens for and logs data received from the automated player instance and actual player instances. In the step **316**, the process **300** checks to make sure that feedback is being received. If no feedback is received, the process **300** may move to the step **318** and send an alert to a user account informing the user that no data is being received from the players. When feedback is received, the process **300** moves to the step **320** and begins monitoring the feedback for issues (e.g., quality, etc.). If there are issues (e.g., problems, etc.) with the playback quality, the process **300** may move to the step **324** to alert the user account that players are having trouble. In one example, the alert may include information specifying region, type, stream, particular issue, etc. When no issues with the playback quality are detected, the process **300** may move to the step **326** to

determine whether the stream is finished. If the stream is not finished, the process **300** returns to the step **320** and continues monitoring the feedback. When the stream is finished, the process **300** may move to the step **328**. In the step **328**, the process **300** closes the feedback interface and performs a final (e.g., summary, etc.) analysis. The process **300** may also make sure the automated player instances that are no longer needed are closed.

Referring to FIG. **4**, a flow diagram is shown illustrating an example player process **400** in accordance with an embodiment of the present invention. In one example, the process (or method) **400** may comprise a step (or state) **402**, a step (or state) **404**, a step (or state) **406**, a step (or state) **408**, a step (or state) **410**, and a step (or state) **412**. In the step **402**, a human user causes an actual player device to connect to a stream to receive the content of the stream. The unique event identifier for the stream may be automatically communicated to the player device when the connection is made or the player device may query the service for the unique event identifier associated with the particular stream. When the player device has acquired the unique event identifier, the process **400** may move to the step **404**. In the step **404**, the process **400** confirms that the player is connected to the stream associated with the unique event identifier. If the player is not connected to the stream, the process **400** may move to the step **406**. In the step **406**, the process **400** may make a report may to the central application regarding the error and close the player instance.

When connection to the stream is confirmed, the process **400** may move to the step **408**. In the step **408**, the player logs and sends back details about the stream (e.g., QoS, etc.) to the central application using the unique event identifier to associate the feedback with the appropriate stream. The process **400** may then move to the step **410** to check whether the stream is over. If the stream is not over, the process **400** returns to the step **408** and continues logging and sending feedback. As long as the player is connected to the stream (e.g., step **404**) and the stream is not over (e.g., step **410**), the process **400** continues to log and send back details about the stream (e.g., QoS, etc.) to the central application. When the stream is over, the process **400** may move to the step **412**. In the step **412**, the player sends a final report to the central application and the player instance is closed.

Referring to FIG. **5**, a flow diagram is shown illustrating an example automated player instance manager process **500** in accordance with an embodiment of the present invention. In one example, the process (or method) **500** may comprise a step (or state) **502**, a step (or state) **504**, a step (or state) **506**, a step (or state) **508**, a step (or state) **510**, a step (or state) **512**, a step (or state) **514**, a step (or state) **516**, and a step (or state) **518**. In the step **502**, the process **500** waits for a request from the central application to instantiate an automated player instance. In the step **504**, the process **500** checks whether a request has been received. If a request has not been received, the process **500** returns to the step **502** and continues waiting. When a request is received, the process **500** may move to the step **506**.

In the step **506**, the process **500** instantiates an automated player instances on server instances in multiple geographical regions. The process **500** then moves to the step **508**. In the step **508**, the player instance connects with the appropriate stream communicated by the central application. In one example, authorization keys may be required from the central application. In the step **510**, the process **500** checks whether the player instance has connected to the stream. If the player instance has not connected to the stream, the process **500** may move to the step **512**. In the step **512**, the process **500** may make a report may to the central application regarding the error and close the automated player instance.

When connection to the stream is confirmed, the process **500** may move to the step **514**. In the step **514**, the automated player instance logs and sends back details about the stream (e.g., QoS, etc.) to the central application using the unique event identifier to associate the feedback with the appropriate stream. The process **500** may then move to the step **516** to check whether the stream is over. If the stream is not over, the process **500** returns to the step **514** and continues logging and sending feedback. As long as the automated player instance is connected to the stream (e.g., step **510**) and the stream is not over (e.g., step **516**), the process **500** continues to log and send back details about the stream (e.g., QoS, etc.) to the central application (e.g., step **514**). When the stream is over, the process **500** may move to the step **518**. In the step **518**, the automated player instance sends a final report to the central application and the automated player instance is closed.

The functions performed by the diagrams of FIGS. **2-5** may be implemented using one or more of a conventional general purpose processor, digital computer, microprocessor, microcontroller, RISC (reduced instruction set computer) processor, CISC (complex instruction set computer) processor, SIMD (single instruction multiple data) processor, signal processor, central processing unit (CPU), arithmetic logic unit (ALU), video digital signal processor (VDSP) and/or similar computational machines, programmed according to the teachings of the present specification, as will be apparent to those skilled in the relevant art(s). Appropriate software, firmware, coding, routines, instructions, opcodes, microcode, and/or program modules may readily be prepared by skilled programmers based on the teachings of the present disclosure, as will also be apparent to those skilled in the relevant art(s). The software is generally executed from a medium or several media by one or more of the processors of the machine implementation.

The present invention may also be implemented by the preparation of ASICs (application specific integrated circuits), Platform ASICs, FPGAs (field programmable gate arrays), PLDs (programmable logic devices), CPLDs (complex programmable logic device), sea-of-gates, RFICs (radio frequency integrated circuits), ASSPs (application specific standard products), one or more monolithic integrated circuits, one or more chips or die arranged as flip-chip modules and/or multi-chip modules or by interconnecting an appropriate network of conventional component circuits, as is described herein, modifications of which will be readily apparent to those skilled in the art(s).

The present invention thus may also include a computer product which may be a storage medium or media and/or a transmission medium or media including instructions which may be used to program a machine to perform one or more processes or methods in accordance with the present invention. Execution of instructions contained in the computer product by the machine, along with operations of surrounding circuitry, may transform input data into one or more files on the storage medium and/or one or more output signals representative of a physical object or substance, such as an audio and/or visual depiction. The storage medium may include, but is not limited to, any type of disk including floppy disk, hard drive, magnetic disk, optical disk, CD-ROM, DVD and magneto-optical disks and circuits such as ROMs (read-only memories), RAMS (random access memories), EPROMs (erasable programmable ROMs),

EEPROMs (electrically erasable programmable ROMs), UVPROM (ultra-violet erasable programmable ROMs), Flash memory, magnetic cards, optical cards, and/or any type of media suitable for storing electronic instructions.

The elements of the invention may form part or all of one or more devices, units, components, systems, machines and/or apparatuses. The devices may include, but are not limited to, servers, workstations, storage array controllers, storage systems, personal computers, laptop computers, notebook computers, palm computers, personal digital assistants, portable electronic devices, battery powered devices, set-top boxes, encoders, decoders, transcoders, compressors, decompressors, pre-processors, post-processors, transmitters, receivers, transceivers, cipher circuits, cellular telephones, digital cameras, positioning and/or navigation systems, medical equipment, heads-up displays, wireless devices, audio recording, audio storage and/or audio playback devices, video recording, video storage and/or video playback devices, game platforms, peripherals and/or multi-chip modules. Those skilled in the relevant art(s) would understand that the elements of the invention may be implemented in other types of devices to meet the criteria of a particular application.

While the invention has been particularly shown and described with reference to the preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made without departing from the scope of the invention.

The invention claimed is:

**1**. A system comprising;

a broadcast facility providing a plurality of streams to at least one of a content delivery network and a mobile carrier;

an automated player management system enabled to create one or more automated player instances using cloud computing resources in response to a request containing a unique identifier of an event, wherein (a) said one or more automated player instances operated independently of end user player devices, and (b) said automated player instances are configured to (i) receive at least one of said plurality of streams from at least one content delivery network, (ii) simulate operation of said one or more end user player devices by one or more end users, and (iii) provide feedback information regarding operation of said automated player instances; and

a network operations center implementing a web service based application configured to (i) receive event information regarding content communicated by the plurality of streams from the broadcast facility including event details, encoding details, and player details, (ii) automatically send said request to said automated player management system to create said one or more automated player instances, (iii) create an interface for the one or more automated player instances to post feedback data for the event, (iv) receive said feedback from said one or more end user player devices and said one or more automated player instances, and (v) automatically adjust operation of the broadcast facility based on the feedback;

wherein said feedback from said one or more end user player devices and said feedback from said one or more automated player instances include one or more of (i) receiving bandwidth, (ii) CPU/dedicated decoding hardware utilization by decoder, (iii) frame decoding time/rate of video frames that are not displayed, (iv) native resolution of display device, (v) whether player is in full screen mode or not, (vi) window size of player, (vii) Profile/Level capability of decoder device, (viii) captioning, (ix) audio-video sync time stamps, and (x) whether an advertisement is being played.

**2**. The system according to claim **1**, wherein at least one of said automated player instances enables a content producer to test content playback with no end user player devices attached to the system.

**3**. The system according to claim **1**, wherein said cloud computing resources are released when said one or more automated player instances are closed.

**4**. The system according to claim **1**, wherein said at least one of said automated player instances is created using a proprietary cloud infrastructure.

**5**. The system according to claim **1**, wherein said at least one of said automated player instances is automatically created, attached to a stream, and begins reporting feedback to the web service based application of the network operations center.

**6**. The system according to claim **1**, wherein two or more automated player instances are created.

**7**. The system according to claim **6**, wherein the two or more automated player instances are created to cover a number of different regions.

**8**. The system according to claim **1**, wherein said one or more end user player devices and said one or more automated player instances support digital rights management.

**9**. The system according to claim **8**, wherein said one or more end user player devices and said one or more automated player instances support decryption associated with digital rights management services.

**10**. The system according to claim **9**, wherein at least one of said end user player devices and said one or more automated player instances uses the decryption associated with the digital rights management to test stream quality and whether streams are properly formatted.

**11**. The system according to claim **1**, wherein said one or more end user player devices and said one or more automated player instances are further configured to provide feedback regarding at least one of an end user experience, content delivery network performance and health, and quality.

**12**. The system according to claim **1**, wherein said network operations center is further configured to start and stop said one or more automated player instances, in multiple or targeted regions, using combinations of technologies and player frameworks.

**13**. The system according to claim **1**, wherein said one or more automated player instances are configured for at least one of (i) testing whether geo-blocking algorithms are working properly, (ii) testing load handling, (iii) monitoring content delivery network performance and health in multiple regions, and (iv) automatically adjusting network performance to simulate mobile device bandwidth fluctuations.

**14**. A method of controlling a video distribution network comprising the steps of:

receiving, from a broadcast facility providing a plurality of streams, information regarding a particular event including event details, encoding details, and player details about content contained in the plurality of streams;

sending a request containing a unique event identifier to an automated player management system, wherein said automated player management system is enabled to automatically create one or more automated player instances using cloud computing resources in response to said request, said one or more automated player instances are configured to (i) receive at least one of

said plurality of streams from at least one content delivery network, and (ii) simulate operation of said one or more end user player devices by one or more end users to enable a content producer to test content playback with no actual end user player devices attached to the video distribution network;

creating an interface for the one or more automated player instances to post feedback data for the particular event;

receiving said feedback to a system operator based on said feedback; and

automatically adjusting one or more parameters of the broadcast facility providing said plurality of streams based on said feedback;

wherein said feedback includes one or more of (i) receiving bandwidth, (ii) CPU/dedicated decoding hardware utilization by decoder, (iii) frame decoding time/rate of video frames that are not displayed, (iv) native resolution of display device, (v) whether player is in full screen mode or not, (vi) window size of player, (vii) Profile/Level capability of decoder device, (viii) captioning, (ix) audio-video sync time stamps, and (x) whether an advertisement is being played.

**15**. The method according to claim **14**, further comprising:

receiving feedback from one or more actual end user player devices receiving at least one of said plurality of streams.

**16**. The method according to claim **14**, further comprising:

performing at least one of (i) testing whether geo-blocking algorithms are working properly, (ii) testing load handling, (iii) monitoring content delivery network performance and health in multiple regions, and (iv) automatically adjusting network performance to simulate mobile device bandwidth fluctuations.

**17**. The method according to claim **14**, further comprising:

creating said one or more automated player instances independent of and separate from any actual end user player devices attached to the video distribution network; and

attaching said one or more automated player instances to respective streams.

**18**. The method according to claim **17**, wherein said cloud computing resources are released when said particular event is finished.

**19**. A system comprising:

a processor; and

a non-transitory computer readable storage medium including instructions stored thereon which, when executed by the processor, cause the system to:

provide a plurality of streams to as least one of a content delivery network and mobile carrier in response to content from a system operator;

create one or more automated player instances using cloud computing resources in response to a request containing a unique event identifier, wherein said one or more automated player instances (i) are independent of one or more end user player devices, (ii) simulate operation of said one or more end user player devices by one or more end users, (iii) generate feedback information regarding operation of said one or more automated player instances, and (iv) receive at least one of said plurality of streams from at least one content delivery network; and

(i) receive event information, including event details, encoding details, and player details, regarding said content from a system operator, (ii) automatically send a request to create said one or more automated player instances, (iii) receive said feedback from said automated player instances and (iv) automatically adjust operation of said system based on said feedback, wherein the feedback information includes one or more of (i) receiving bandwidth, (ii) CPU/dedicated decoding hardware utilization by decoder, (iii) frame decoding time/rate of video frames that are not displayed, (iv) native resolution of display device, (v) whether player is in full screen mode or not, (vi) window size of player, (vii) Profile/Level capability of decoder device, (viii) captioning, (ix) audio-video sync time stamps, and (x) whether an advertisement is being played.

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